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| APPLICATION NO.   | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|---------------------|------------------|
| 10/597,038  | 07/07/2006  | Matthew Angyal       | FIS920030180US1     | 5103             |
| 32074   | 7590        | 07/23/2009           | EXAMINER            |                  |
| INTERNATIONAL BUSINESS MACHINES CORPORATION<br>DEPT. 18G<br>BLDG. 321-482<br>2070 ROUTE 52<br>HOPEWELL JUNCTION, NY 12533 |             |                      | KHATRI, PRASHANT J  |                  |
|   |             |                      | ART UNIT            | PAPER NUMBER     |
|   |             |                      | 1794                |                  |
|   |             |                      | NOTIFICATION DATE   | DELIVERY MODE    |
|   |             |                      | 07/23/2009          | ELECTRONIC       |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

EFIPLAW@US.IBM.COM

|                              |                        |                     |  |
|------------------------------|------------------------|---------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|                              | 10/597,038             | ANGYAL ET AL.       |  |
|                              | <b>Examiner</b>        | <b>Art Unit</b>     |  |
|                              | PRASHANT J. KHATRI     | 1794                |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) Responsive to communication(s) filed on 16 June 2009.  
 2a) This action is **FINAL**.                    2b) This action is non-final.  
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) Claim(s) 1-21 is/are pending in the application.  
 4a) Of the above claim(s) 18-21 is/are withdrawn from consideration.  
 5) Claim(s) \_\_\_\_\_ is/are allowed.  
 6) Claim(s) 1-17 is/are rejected.  
 7) Claim(s) \_\_\_\_\_ is/are objected to.  
 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) The specification is objected to by the Examiner.  
 10) The drawing(s) filed on 07 July 2006 is/are: a) accepted or b) objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) All    b) Some \* c) None of:  
 1. Certified copies of the priority documents have been received.  
 2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____ .                                    |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>4/2/2008, 7/7/2006</u> .                                      | 6) <input type="checkbox"/> Other: _____ .                        |

**DETAILED ACTION**

***Election/Restrictions***

1. Claims 18-21 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected Group II, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on 6/16/2009. The lack of unity as previously stated in Office Action dated 5/28/2009 is still applicable due to the application claiming priority to a 371 filed 1/14/2004 (please see Application Data Sheet filed 7/7/2006).

***Information Disclosure Statement***

2. The information disclosure statement filed 4/2/2008 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because it appears that the patent number for Martin et al. is already present in IDS filed 7/7/2006 in addition to an error with the patent number. It has been placed in the application file, but the information referred to therein has not been considered as to the merits. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609.05(a).

### ***Claim Objections***

3. Claim 2 is objected to because of the following informalities: There are extra spaces in the first line of the claim. Appropriate correction is required.

### ***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1-5, 8, 10-11, and 17 are rejected under 35 U.S.C. 102(b) as being anticipated by Venkatraman et al. (**WO 01/71776**).
6. Venkatraman et al. disclose a low  $\kappa$  material having a variable dielectric constant throughout the thickness of the material. Concerning claims 1, 8, and 10-11, Venkatraman et al. disclose the material is disposed onto a substrate as a CVD precursor in which said material has a upper surface having a dielectric constant greater than 3.0 and a lower surface having a dielectric constant from about 2.1 to 2.7 (**pp. 5-6, lines 5+**). Given that the upper surface has a dielectric constant above 3.0 and the

lower surface has a dielectric constant from about 2.1 to 2.7, the difference in dielectric constant between the upper and lower surface is from at least 0.3 to 0.9, which would meet the present limitations of claims 4 and 5. Further, it is noted that the thickness of such a coating is from 50 angstroms to 10 microns (*p. 11, lines 30+*). Given the above disclosure regarding dielectric constants of the upper and lower surfaces in conjunction with the thicknesses above, it is clear that the disclosure of Venkatraman et al. would encompass and include the rate of decrease of  $\kappa$  presently claimed in claims 2 and 3. Regarding claim 17, it is noted that the above is used in semiconductor applications (*p. 5, lines 16+*).

7. Claims 1-4, 8, and 17 are rejected under 35 U.S.C. 102(e) as being anticipated by Wallace et al. (**US 6670022**).
8. Wallace et al. disclose a nanoporous dielectric film having a graded density. Concerning claims 1 and 8, Wallace et al. disclose a coating on a substrate wherein said coating has a gradient of dielectric constant ranging from the top of the upper region to the bottom of the lower region (*col. 6, lines 58+*). Regarding claims 2-4, the difference between the dielectric constant at the top and the dielectric constant at the bottom is from about 0.2 to 0.4 (*col. 6, lines 61+*). Concerning claim 17, it is noted that such a material is used as a semiconductor (*col. 10, lines 25+*).

***Claim Rejections - 35 USC § 103***

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 6-7 and 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Venkatraman et al. (**WO 01/71776**) in view of Gates et al. (**US 20020093075**) with evidence from Ikeda et al. (**US 6407011**).

11. Venkatraman et al. disclose the above in paragraphs 5 and 6; however, Venkatraman et al. are silent to a second dielectric layer and profiles thereof.

12. Gates et al. disclose electronic structures with a reduced capacitance. Concerning claims 12-13, Gates et al. disclose a two layer graded laminate where in the second layer is disposed on the first layer (**claim 10**). The second layer is comprised of a profile wherein the carbon content increases with respect to the layer depth (i.e. from surface of the layer to the bottom of the layer) (**para. 0104-0107**). Examiner takes the position that with respect to the substrate, the second layer would produce a dielectric constant that increases from the bottom of the layer to the top. Further, it is noted that Ikeda et al. show the effects of carbon content with respect to the dielectric constant (**FIG. 2**). Regarding claims 6-7, it is noted that the dielectric profile is established with a linear and step-wise profile in regions. Further, the tailoring of such profiles to produce the desired dielectric and/or electrical properties is well-known within the art and considered to be obvious to one of ordinary skill in the art. As a result, the structure

provides effective protection against air oxidation and barrier properties, high breakdown field, low leakage current and low dielectric constant (**para. 0108-0109**).

13. However, note that while Gates et al. do not disclose all the features of the present claimed invention, Gates et al. is used as teaching reference, and therefore, it is not necessary for this secondary reference to contain all the features of the presently claimed invention, *In re Nievelt*, 482 F.2d 965, 179 USPQ 224, 226 (CCPA 1973), *In re Keller* 624 F.2d 413, 208 USPQ 871, 881 (CCPA 1981). Rather this reference teaches a certain concept, namely, a second low  $\kappa$  material having a dielectric constant that increases with respect to the bottom of the material in order to improve electrical and barrier properties and in combination with the primary reference, discloses the presently claimed invention.

14. All of the elements were known within the art. The only difference is a single disclosure containing all of the presently claimed elements. Venkatraman et al. disclose the above in paragraphs 4 and 5; however, Venkatraman et al. are silent to a second dielectric layer and profiles thereof. Gates et al. disclose electronic structures with a reduced capacitance comprising two dielectric layers having carbon content profiles. The motivation to combine the above references is drawn toward Gates et al. which disclose the resulting structure provides effective protection against air oxidation and barrier properties, high breakdown field, low leakage current and low dielectric constant. Thus, it would have been obvious to one of ordinary skill in the art to apply a second layer that would improve the above properties.

15. Claims 14-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Venkatraman et al. (**WO 01/71776**) in view of Conti et al. (**US 6570256**) with evidence from Ikeda et al. (**US 6407011**).

16. Venkatraman et al. disclose the above in paragraphs 5 and 6; however, Venkatraman et al. are silent to a third layer having a dielectric constant that decreases from the bottom to the top.

17. Conti et al. disclose a carbon graded layer wherein the carbon content increases from the bottom to the top (**abstract**). As evidenced by Ikeda et al., as the carbon content increases, the dielectric constant decreases (**FIG. 2**). The resultant structure reduces delamination by improving adhesion (**col. 3, lines 34+; col. 4, lines 6+**).

18. However, note that while Conti et al. do not disclose all the features of the present claimed invention, Conti et al. is used as teaching reference, and therefore, it is not necessary for this secondary reference to contain all the features of the presently claimed invention, *In re Nievelt*, 482 F.2d 965, 179 USPQ 224, 226 (CCPA 1973), *In re Keller* 624 F.2d 413, 208 USPQ 871, 881 (CCPA 1981). Rather this reference teaches a certain concept, namely, a layer that has increasing carbon content in order to improve adhesion properties of the laminate and in combination with the primary reference, discloses the presently claimed invention.

19. All of the elements were known within the art. The only difference is a single disclosure containing all of the presently claimed elements. Venkatraman et al. disclose the above in paragraphs 4 and 5; however, Venkatraman et al. are silent to a third layer having a dielectric constant that decreases from the bottom to the top. Conti et al.

disclose a carbon graded layer wherein the carbon content increases from the bottom to the top. The motivation to combine the above references is drawn towards Conti et al. which disclose that such a layer having the variable carbon content allows one of ordinary skill in the art to improve adhesion properties of a laminate. Thus, it would have been obvious to one of ordinary skill in the art, with the impetus of improving adhesion properties of a laminate, to provide a layer having a dielectric constant that decreases from the bottom to the top.

20. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Venkatraman et al. (**WO 01/71776**) in view of Martin et al. (**US 6498112**).

21. Venkatraman et al. disclose the above in paragraphs 5 and 6; however, Venkatraman et al. are silent to an initial dielectric region.

22. Martin et al. disclose a first dielectric layer disposed on a substrate upon which a graded oxide cap is disposed (**abstract**). The graded oxide cap in combination with the first dielectric layer allows for improvement at the interface when forming copper or conductive interconnects while reducing the capacitance and RC delays (**col. 3, lines 16+; col. 8, lines 31+**).

23. All of the elements were known within the art. The only difference is a single disclosure containing all of the presently claimed elements. Venkatraman et al. disclose the above in paragraphs 5 and 6; however, Venkatraman et al. are silent to an initial dielectric region. Martin et al. disclose a first dielectric layer disposed on a substrate upon which a graded oxide cap is disposed. The motivation to combine the above

Art Unit: 1794

elements is drawn towards Martin et al. which disclose such a structure allows for improvement at the interface when forming copper or conductive interconnects while reducing the capacitance and RC delays. Thus, it would have been obvious to place a first dielectric layer upon which a graded oxide is disposed to improve interface and electrical properties.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to PRASHANT J. KHATRI whose telephone number is (571)270-3470. The examiner can normally be reached on M-F 8:00 A.M.-5:00 P.M. (First Friday Off).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Sample can be reached on (571) 272-1376. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/David R. Sample/  
Supervisory Patent Examiner, Art Unit 1794

PRASHANT J KHATRI  
Examiner  
Art Unit 1794